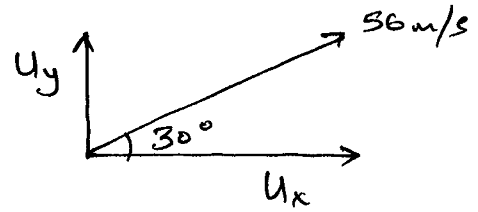
PROJECTATHON

1.



Define ↑→ positive

$U_x = 56\cos 30$; $U_y = 56\sin 30$

a/ Time to max height

Considering vertical motion only, at max height $V_y = 0$

so if $U_y = 56\cos 30$, $V_y = 0$, $a = -9.8\,m/s^2$ (↓ ∴ −ve)

$v = u + at$

$0 = 56\sin 30 + (-9.8t)$

$9.8t = 56\sin 30$

$t = \frac{28}{9.8} = 2.86\,s$ or $\underline{2.9\,s}$ (1dp)

b/ Max height (still vertical only)

We could use $s = ut + \frac{1}{2}at^2$

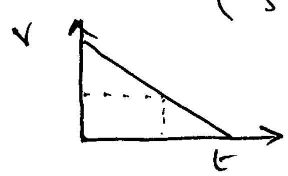
$= (28 \times 2.86) + \frac{1}{2}(-9.8 \times 2.86^2)$

$= 80.08 - 40.08$

$= \underline{40.0\,m}$

Or say that for uniform acceleration, distance travelled at average speed × time taken

(s = area under v/t graph)



$= \frac{1}{2} \times 28 \times 2.86 = \underline{40.04\,m}$

$\underline{40.0\,m}$ (1dp)

c/ Flight time $= 2\times$ time to max height $= 2 \times 2.86$

$= 5.72$

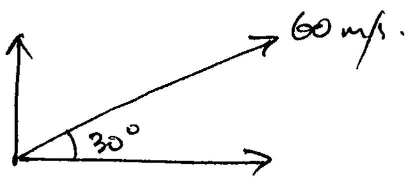
$\underline{\underline{5.7\,s}}$ (1dp)

d. Horizontal range: Considering horizontal motion only:
dist = speed × time (no acceleration horizontally)

$= V_x \times t \qquad V_x = U_x = 56 \cos 30$
$\qquad\qquad\qquad t = 5 \cdot 72$

$= 56 \cos 30 \times 5 \cdot 72 = \underline{277 \cdot 4 \text{ m}}$ (1dp)

[Technically, 0dp is more appropriate for answers given figures from question]

2. 

Identical question: only the numbers change, so:

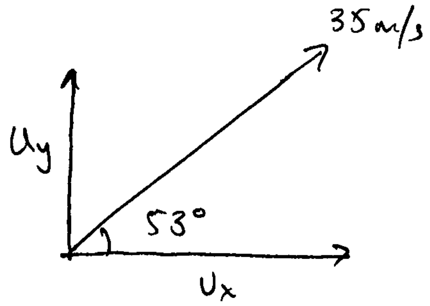
a/ $10t = u_y \qquad u_y = 60 \sin 30$
$\qquad\qquad\qquad = 30$

$t = \frac{30}{10} = 3s$ ∴ total flight time = 6s (c)

b/ Max height $= \frac{1}{2} V_y \times t = 15 \times 3 = \underline{45 \text{ m}}$

d/ Range $= 60 \cos 30 \times 2t = \underline{\underline{312 \text{ m}}}$

(For sense, compare the figures to previous question — same angle, little bit faster. Do these answers fit that pattern?).

3. 

$U_y = 35 \sin 53$
$U_x = 35 \cos 53$

a/ Flight time (call t_2) = 2 × time to max height (t_1)

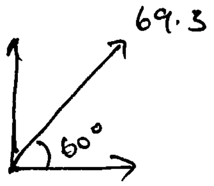
$v = u + at_2$ considering vertical motion only.

$0 = U_y - at_1 \quad (a = -9.8)$

$U_y = at \qquad t_1 = \frac{U_y}{t} = \frac{35 \sin 53}{9.8} = \underline{\underline{2.85\,s}}$

$\therefore t_2 = \underline{5.7 \text{ sec}}$

b/ Range $= U_x \times t_2$
$= 35 \cos 53 \times 5.7 = 120.1$ m
or $\underline{120 \text{ m}}$ to you, mate.

4. 

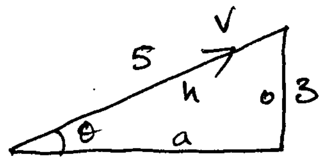
$v = u + at$ (vertical only)

$0 = U_y + at = U_y - 10t$

$t = \frac{U_y}{10} = \frac{69.3 \sin 60}{10} = \underline{\underline{6s}}$

Max height = av. speed × 6s
$= 30 \times 6 = \underline{\underline{180 \text{ m}}}$

5. $\sin^{-1}\frac{3}{5}$ implies this:



This is a 3,4,5 triangle. In vector terms, it means that the V_y component is $\frac{3}{5} \times V$.

So, air time is 2x time to greatest height; working in the vertical plane:

$$v = u + at$$
$$0 = u_y - 9.8t$$

$$t = \frac{0.6 \times 44.1}{9.8} = 2.7\text{ s}$$

$$t_{total} = \underline{\underline{5.4\text{ s.}}}$$

(You could use exactly the same working as before but that would mean taking $\sin(\sin^{-1} 3/5)$, which seems a waste of time...)

6. Flight time = 2x time to max height

Vertical:
$$v = u + at$$
$$0 = u_y + at$$

$$210 \sin 15 = 9.8t$$
$$t = 5.5\text{ s} \quad \therefore \text{ total } t = \underline{11\text{ s}}..$$

Range = horiz. velocity x time

$$= 210 \cos 15 \times 11$$
$$= \underline{\underline{2231\text{ m}}}$$

Note: 210 m/s is almost 500 mph ...